Empirical Study on the Acceptance of Mobility as a Service (MaaS) Based on the UTAUT2 Model

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Abstract

To achieve the widespread use of Mobility as a Service (MaaS), a novel transportation platform, it is important to increase consumers' intention to use MaaS. Therefore, this study clarifies the determinants of consumers' intention to use MaaS based on the UTAUT2 model. The research model is tested using structural equation modeling based on data from a web-based questionnaire survey of Japanese consumers. The results show that performance expectancy, social influence, hedonic motivation, and price value have significant effects on the intention to use MaaS. Moreover, the relationship between the intention to use MaaS and independent variables is moderated by old age. Theoretical and practical implications are discussed based on the findings.

Keywords: Mobility as a service (MaaS), Innovation, Technology acceptance model, UTAUT2

1. Introduction

Since the mid-2010s, a new transportation platform, Mobility as a Service (MaaS), has attracted attention in both academic research and practical fields (Arias-Molinares and García-Palomares 2020; Mola, Berge, Haavisto and Soscia 2020). MaaS is defined as "a user-centric, multimodal, sustainable and intelligent mobility management and distribution system, in which a MaaS Provider brings together offerings of multiple mobility service providers (public and private) and provides end-users access to them through a digital interface, allowing them to seamlessly plan and pay for mobility" (Kamargianni and Goulding 2018). Normally, MaaS offers a variety of transportation services other than private cars, including taxis, trains, subways, buses, streetcars, bicycles, and more (Arias-Molinares and García-Palomares 2020; Jittrapirom et al. 2017). It encompasses those belonging to the sharing economy, a recent type of service business, such as ridesharing and bicycle sharing. In this sense, MaaS can be regarded as a platform that offers novel service experiences to consumers.

MaaS users present their destinations to the MaaS application or website on their smartphones, which enables them to travel along optimal routes that combine multiple transportation services. This feature simplifies the consumers' movements. Moreover, some MaaS applications allow users to purchase tickets for transportation services and tourist attractions simultaneously (Ishii 2020), thus providing consumers a comfortable tourism experience. MaaS can increase the convenience of consumers by better integration with services other than transportation.

Additionally, MaaS improves the business situation of public transport services' operators, as its presence is expected to increase the number of users of public transport. For instance, users of a MaaS called Whim offered in Helsinki, Finland, reportedly use public transportation services more frequently than non-users (Whim 2018). Such an increase will lead to a decrease in the use of private cars; thus, MaaS may contribute to the reduction of CO2 emissions and traffic congestion (Cruz and Sarmento 2020; Gould, Wehrmeyer and Leach 2015). Hence, MaaS can be viewed as a platform that contributes to solving social issues.

Against this background, MaaS might potentially benefit consumers, firms, and society. To realize its full potential, MaaS needs to be widely adopted, which depends on technical feasibility, and on a variety of

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influencing factors such as regulation and economic benefits (Schikofsky, Dannewald and Kowald 2020). Among them, this study focuses on consumers' intention to use MaaS, due to the need to gain insight into the topic and as MaaS has an inherent user-centric feature (Schikofsky et al. 2020). Understanding consumers' intention to use MaaS will provide novel insights into the acceptance of innovations, which has been the subject of several studies (Ivanova and Noh, 2022; Lee, Lee and Ko 2021) in the marketing field.

Research has attempted to gain a better understanding of consumers' intention to use MaaS with the aid of models of acceptance of more recent information technologies (Mola et al. 2020; Schikofsky et al. 2020). Specifically, by employing existing well-established models that explain the determinants of intention to use new information technologies, such as the Technology Acceptance Model (TAM) (Davis Bagozzi and Warshaw 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis and Davis 2003), the determinants of consumers' intention to use MaaS are identified. However, few studies have been conducted using UTAUT2 (Venkatesh Thong and Xu 2012), which is an improved version of UTAUT and still the most recent model to explain the intention to use new information technologies. One of the differences between these models is that UTAUT is a model built for business systems, while UTAUT2 is explicitly built for systems used by general consumers (Venkatesh, James, Thong and Xu 2012). UTAUT2 assumes that general consumers will use the system; it is more suitable for studying consumers' intention to use MaaS than UTAUT.

Lebrument, Zumbo-Lebrument and Rochette (2021) apparently have conducted the only study to examine MaaS usage behavior in France using UTAUT2. However, they did not examine the factor of consumer age, which is assumed to influence the use of information technologies (Venkatesh et al. 2012). In addition, their study belonged to a European context and did not examine the applicability of UTAUT2 in an Asian setting. Therefore, this study clarifies the determinants of consumers' intention to use MaaS based on UTAUT2 in an Asian context. Additionally, we ascertain the effect of age on the intention to use MaaS using UTAUT2.

The remainder of this paper is organized as follows. After a literature review of acceptance models for new information technologies, including UTAUT2, the hypothetical model used in this study is presented. Thereafter, the hypothetical model is tested based on data obtained from a web-based questionnaire survey. Finally, the discussion and conclusions of the study are presented.

2. Conceptual framework and hypotheses

2.1. Genealogy of Technology Acceptance Models

TAM (Davis, Bagozzi and Warshaw 1989) is a widely adopted model in explaining technology usage (Kim and Shin, 2015; Sun and Zhang 2021). The two central concepts of TAM are perceived usefulness and perceived ease of use. Both concepts, as determined by external variables, are postulate to influence the behavioral intention to use the system by mediating attitudes toward using the system (Davis et al. 1989). Additionally, perceived usefulness is assumed to directly influence the behavioral intention to use the system (Davis et al. 1989). Then, the behavioral intention to use the system is said to influence the actual system use (Davis et al. 1989).

Since the 2000s, despite the introduction of improved models such as UTAUT and UTAUT2, numerous studies have still employed TAM (Marangunić and Granić 2015). For instance, TAM has been used to explain usage intention of mobile Internet (Lu, Yu, Liu and Yao 2003) and Internet banking system (Nasri and Charfeddine 2012). There are several TAM-based studies on MaaS use intentions (Mola et al. 2020; Schikofsky et al. 2020), probably due to the abundance of comparable and past research cases (Yairi 2016).

UTAUT is a model developed by integrating TAM and several other models previously proposed to explain the use of new technologies (Venkatesh et al. 2003). In UTAUT, performance expectancy, effort expectancy, social influence, and facilitating conditions mediate intention to use and influence usage behavior. These variables are based on theory of reasoned action (Fishbein and Ajzen 1975), theory of planned behavior (Ajzen 1991), and Triandls' (1977) theory of human behavior. In addition, facilitation conditions are assumed to directly influence usage behavior. These relationships are moderated by individual difference factors such as gender, age, experience, and voluntariness of use.

UTAUT has been used in various studies that examine the intention to use more recent information technologies. Specifically, UTAUT has been discussed in over 174 papers from 2003 to 2011 (Williams, Rana and Dwivedi 2015). According to Williams et al. (2015), the majority of study cases examined the use of general systems such as E-government services and the Internet using UTAUT. Ye, Zheng and Yi (2020) have discussed the intention of using MaaS with UTAUT.

UTAUT2 is a model with hedonic motivation, price value, and habit added to the exogenous variables of UTAUT (Venkatesh et al. 2012). These

variables are based on information system and marketing literature (Venkatesh et al. 2012). UTAUT2 has improved the explained variance regarding the intention to use of the system compared to UTAUT (Venkatesh et al. 2012). Currently, progressing studies employ UTAUT2 to examine information technology use intentions, with 79 papers published through 2017 (Tamilmani, Rana, Prakasam and Dwivedi 2019).

2.2. Hypotheses and research model

In this study, we develop a research model to explain the intention to use MaaS based on UTAUT2. The following sections explain each of the concepts that constitute the research model.

2.2.1. Performance expectancy

Performance expectancy refers to the degree to which an individual believes that using the system will provide outcomes (Venkatesh et al. 2003). Performance expectancy is based on concepts such as extrinsic motivation and perceived usefulness in TAM (Venkatesh et al. 2003). The relationship between performance expectancy and intention to use information systems has been confirmed in a large body of literature (Dakduk, Santalla-Banderali and Ribamar Siqueira 2020). Thus, performance expectancy can be seen as the most primary concept that influences behavioral intentions.

This study assumed that the more the use of MaaS is expected to achieve the goal of comfortably traveling, the higher the intention to use MaaS will be. Therefore, the following hypothesis is proposed.

H1: *Performance expectancy positively influences the intention to use MaaS.*

2.2.2. Effort expectancy

Effort expectancy refers to the degree of ease associated with using the system (Venkatesh et al. 2003). Effort expectancy is based on the concepts of ease of use, complexity, and perceived of use in TAM (Venkatesh et al. 2003). Although some studies have shown that effort expectancy has a small influence on the intention to use information systems, many others have demonstrated that there is a significant relationship between effort expectancy and the intention to use information systems (Dakduk et al. 2020).

In this study, the easier consumers perceive MaaS to be to use, the higher the intention to use MaaS will be. Therefore, the following hypothesis is proposed.

H2: *Effort expectancy positively influences the intention to use MaaS.*

2.2.3. Social influence

Social influence refers to the degree to which an individual perceives that significant others believe they should use the system (Venkatesh et al. 2003). Significant others are such as friends, family, and colleagues (Dajani and Abu Hegleh 2019; Vinerean, Budac, Baltador and Dabija 2022). Social influence is based on the concept of subjective norm used in the theory of reasoned action (Fishbein and Ajzen 1975) and theory of planned behavior (Ajzen 1991) in social psychology.

Social influence is reported to have a positive and significant impact on the intention to use mobile applications (Dakduk et al. 2020). In this study, the more consumers perceive that significant others should use MaaS, the higher the intention to use MaaS will be. Therefore, the following hypothesis is proposed.

H3: *Social influence positively influences the intention to use MaaS.*

2.2.4. Facilitating conditions

Facilitating conditions refers to the extent to which an individual believes that there is an organizational or technical infrastructure supporting the use of the system (Venkatesh et al. 2003). Facilitating conditions are based on concepts such as perceived behavioral control used in the theory of reasoned action (Fishbein and Ajzen 1975) and theory of planned behavior (Ajzen 1991). This concept is validated as explanatory variables of the acceptance and use of innovations (Dajani et al. 2019).

In this study, the facilitating conditions for MaaS are assumed to include knowledge of smartphone operation and support systems for smartphone operation. The greater the perception of the presence of these factors, the higher the intention to use MaaS will be. Therefore, the following hypothesis is proposed.

H4: *Facilitating conditions positively influences the intention to use MaaS.*

2.2.5. Hedonic motivation

Hedonic motivation refers to the pleasure and enjoyment derived from using the system (Venkatesh et al. 2012). This factor has been noted to have a significant impact on the acceptance and use of new technologies (Brown and Venkatesh 2005). Thus, it is important to focus on the affective and

cognitive aspects of consumers to increase their intention to use information systems. In this study, the more consumer perceive enjoyment and pleasure in using MaaS, the higher the intention to use MaaS will be. Therefore, the following hypothesis is proposed.

H5: *Hedonic motivation positively influences the intention to use MaaS.*

2.2.6. Price value

Unlike information systems for business use, the use of systems for general consumers may involve monetary cost requirements (Venkatesh et al. 2012). Price value refers to the cognitive trade-off between the consumer's perceived benefits of a system and the monetary cost of using it (Venkatesh et al. 2012). Price value positively affects intention to use when the benefit of the technology is higher than the monetary cost of its use (Human, Ungerer and Azémia 2020). In this study, the more the benefits arising from the use of MaaS outweigh the monetary costs, the higher the intention to use MaaS will be. Therefore, the following hypothesis is proposed.

H6: *Price value positively influences the intention to use MaaS.*

2.2.7. Moderating effects

In the original UTAUT2, individual characteristics such as gender, age, and experience moderate the relationship between each of the concepts that constitute the model and the intention to use a technology (Venkatesh et al. 2012). We focus on the differences between the older age group and other age groups. It has been noted that older adults are less likely than younger adults to use new information technologies (Yairi 2016). To encourage greater use of MaaS, it is important to identify factors that have a particular impact on the older age group, who generally tend not to use new information technologies. Indeed, the study examining the intention to use online shopping services using UTAUT 2 (Human et al. 2020) shows a moderating effect of older age. In light of these discussions, the following hypotheses are proposed.

H7a: *Older age moderates the relationship between performance expectancy and the intention to use MaaS.*

H7b: *Older age moderates the relationship between effort expectancy and the intention to use MaaS.*

H7c: *Older age moderates the relationship between social influence and the intention to use MaaS.*

H7d: *Older age moderates the relationship between facilitating conditions and the intention to use MaaS.*

H7e: *Older age moderates the relationship between hedonic motivation and the intention to use MaaS.*

H7f: *Older age moderates the relationship between price value and the intention to use MaaS.*

Fig. 1 presents the research model for this study. We did not include the concept of habit in the original UTAUT2, because habit is a concept that assumes that consumers use information systems on a daily basis, a concept that does not fit well with MaaS, which is not yet widely used. Furthermore, the original UTAUT2 includes information system use behavior; however, we did not include it because this study uses a cross-sectional survey design, which makes it difficult to accurately measure use behavior. Several previous studies utilizing UTAUT2 (Dajani et al. 2019; Dakduk et al. 2020; Vinerean et al. 2022) have not measured use behavior in the same way as this study does.

3. Research methodology

3.1. Data collection and sample

In this study, Japanese consumers were the target population. In Japan, MaaS is making progress in practical application, mainly by railroad companies (Ishii 2020). The data for this survey was collected using a consumer panel provided by an Internet research firm. The survey was conducted in February 2022. In collecting the sample, the distribution was made so that more respondents were older (65 years and older). The age of 65 is the standard for older adults in Japan.

The sample analyzed for this study was based on those who indicated in the preliminary question that they had an overview of MaaS and who owned a smartphone. Finally, 1045 useable responses were obtained.

3.2. Measurement items

This study measured the situation of using MaaS for tourism. The measurement items of the research model were developed based on the original UTAUT2 (Venkatesh et al. 2012) and previous

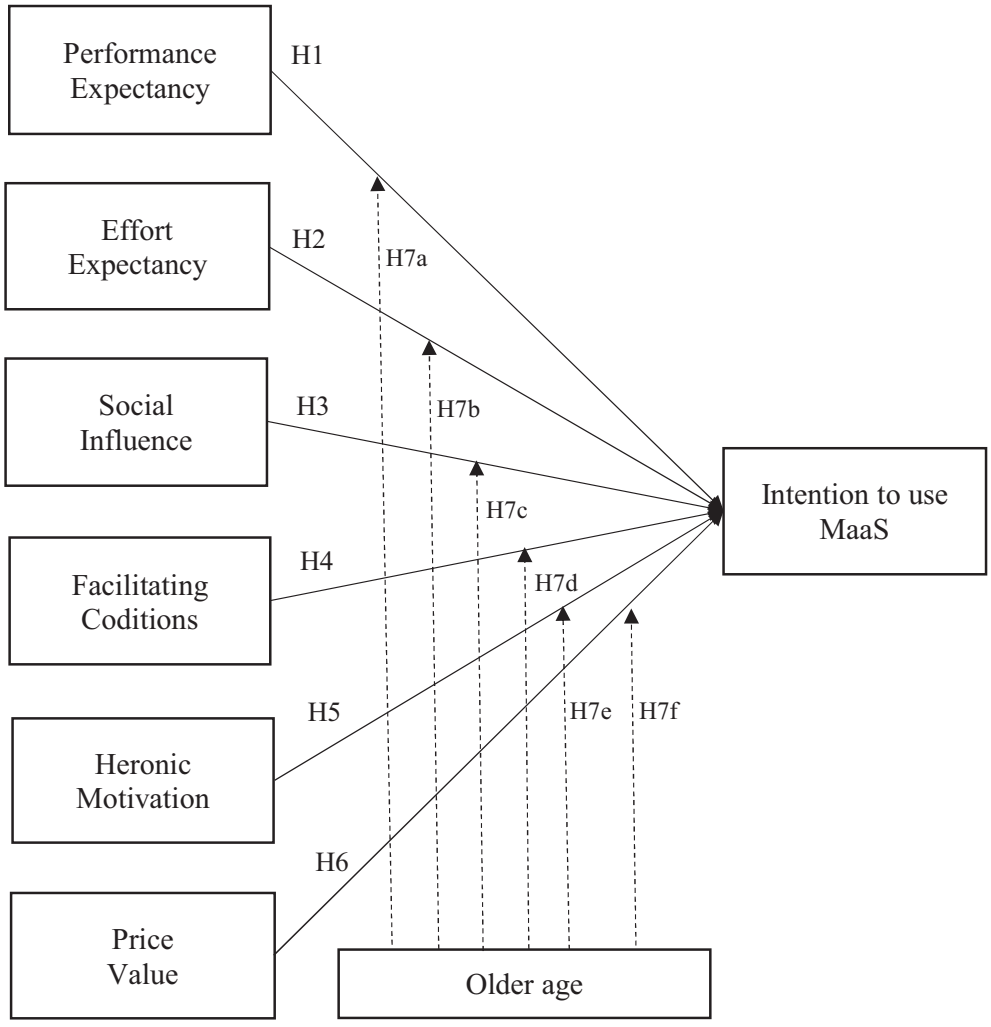

Fig. 1. The research model.

studies that examined the intention to use MaaS through the use of UTAUT (Ye et al. 2020).

Performance expectancy was measured by three items, effort expectancy by four items, social influence by four items, facilitating conditions by four items, hedonic motivation by three items, price value by three items, and the intention to use Maas by three items. All the items were measured on a 7-point scale (strongly disagree = 1; strongly agree = 7).

4. Results

4.1. Profile of sample

Amongst the respondents, 52.3% were male (N = 547), and 47,7% were female (N = 498). In terms of age, 30.9% were older age (N = 323), while the rest were distributed among various age groups. In terms of experience using MaaS, 12.9% of the respondents (N = 135) had experience and 87.1% of the respondents (N = 910) had no experience. Most of the respondents in this study had not yet used MaaS.

4.2. Common method bias

Common method bias may occur when the independent and dependent variables are measured in the same survey, in which the relationship between the variables is inflated or deflated (Kock, Berbekova and George Assaf 2021). Therefore, we conducted Harman's one-factor test, a method to test common method bias (Podsakoff and Organ 1986). Specifically, we performed an exploratory factor analysis on all measurement items to test whether a single factor explained more than a majority of the variance in the data. HAD (Shimizu

2016) is used for exploratory factor analysis. Four factors were extracted as a result of the analysis using the iterated principal factor method (without rotation) with an eigenvalue of 1 or more as the criterion for factor extraction. As the proportion of variance explained of the first factor with the largest eigenvalue was 49.4%, less than the majority, it was judged that no serious common method bias occurred.

4.3. Measurement model

Confirmatory factor analysis (CFA) was conducted to examine the reliability and validity of the measurement model. In this study, subsequent analyses were conducted using R version 4.1.2 and the packages "lavaan" and "semTools". The fit indices used to evaluate the model were $\chi 2$ statistic, comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). The values of fit indices are $\chi 2 = 1054.848$, CFI = 0.962, RMSEA = 0.058, and SRMR = 0.046. Although the $\chi 2$ statistic is significant ($df = 231$, $p < 0.05$), CFI exceeded the criterion value of 0.9 (Reisinger and Mavondo 2007). RMSEA is below the criterion value of 0.08 (Reisinger and Mavondo 2007), and SRMR is below the criterion value of 0.08 (Hu and Bentler 1999). These results indicate that the measurement model adequately fits the data.

Reliability was tested using composite reliability (CR) values. The CR values for all constructs exceed the criterion value of 0.6 (Bagozzi and Yi 1988), thus confirming the reliability (see Table 1). Next, convergent and discriminant validity are tested. Convergent validity was tested by the factor loadings from each latent variable to the observed variables and the average variance extracted (AVE). The standardized factor loadings from each latent variable to the observed variables all exceed the criterion value of 0.5 (Hair, Black, Babin and Anderson 2014), and the AVEs for all latent variables exceed the criterion value of 0.5 (Fornell and Larcker 1981; Hair, Black and Anderson 2014). These

Table 1. Factor loadings, CR, and AVE of the measurement model.

Items	Factor loadings	CR	AVE
Performance Expectancy		0.886	0.721
Using MaaS is expected to help get around in a destination.	0.855		
Using MaaS is expected to get around in a destination more quickly.	0.846		
Using MaaS is expected to make travel more efficiently.	0.847		
Effort Expectancy		0.939	0.793
Learning how to use MaaS seems easy for me.	0.873		
My interaction with MaaS seems clear and understandable.	0.897		
MaaS seems easy to use.	0.924		
It seems easy for me to become skillful at using MaaS.	0.869		
Social Influence		0.888	0.666
I am willing to use if everyone uses MaaS.	0.827		
I am willing to use MaaS if I can get respect and praise from people around me.	0.749		
I am willing to use MaaS if the media evaluation is good.	0.848		
I am willing to use MaaS if evaluation of people around me is good.	0.851		
Facilitating Conditions		0.876	0.647
I have the knowledge necessary to use smartphone.	0.879		
I have the knowledge necessary to online shopping using smartphone.	0.865		
I do not think it is difficult to operate a smartphone.	0.892		
I can get help from others when I have difficulties using smartphone.	0.534		
Hedonic Motivation		0.931	0.818
Using MaaS seems fun.	0.923		
Using MaaS seems enjoyable.	0.942		
Using MaaS seems very entertaining.	0.851		
Price Value		0.898	0.746
Purchasing transportation tickets via MaaS would be expected to be less expensive.	0.843		
I would be able to buy a discounted unlimited ride ticket on MaaS.	0.874		
Using MaaS is expected to make travel more inexpensively.	0.875		
Intention to use MaaS		0.882	0.714
I would definitely use MaaS if I have the chance to use it in a destination.	0.886		
I would definitely use MaaS instead of renting a car if I have the chance to use it in a destination.	0.811		
I would definitely use MaaS without having to search and book transportation individually if I have the chance to use it in a destination.	0.835		

Table 2. . HTMT of the measurement model.

	PE	EE	SI	FC	HM	PV	IM
PE	1						
EE	0.590	1					
SI	0.730	0.604	1				
FC	0.346	0.505	0.356	1			
HM	0.743	0.642	0.793	0.402	1		
PV	0.773	0.569	0.695	0.354	0.754	1	
IM	0.794	0.623	0.847	0.362	0.851	0.836	1

(Note: PE: Performance Expectancy, EE: Effort Expectancy, SI: Social Influence, FC: Facilitating Conditions, HM: Hedonic Motivation, PV: Price Value, IU: Intention to use MaaS).

results confirm the convergent validity (see Table 1). Discriminative validity was tested by the heterotrait-monotrait ratio of correlations (HTMT) (Henseler, Ringle and Sarstedt 2015). The results show that all HTMTs are below the criterion value of 0.9, thus confirming the discriminative validity (see Table 2).

4.4. Structural model and hypotheses testing

First, the structural model was estimated to test hypotheses 1 to 6. Although the $\chi 2$ statistic is significant ($\chi 2 = 1054.848$, df = 231, $p < 0.05$), the model adequately fits the data (CFI = 0.962, RMSEA = 0.058, SRMR = 0.046). Table 3 presents the estimates of standardized path coefficients. Performance expectancy has a direct effect on intention to use MaaS ($\beta = 0.082$, $p < 0.05$). Thus, H1 is supported. The effect of effort expectancy on intention to use MaaS is statistically insignificant ($\beta = 0.026$, n.s.). Thus, H2 is not supported. Social influence has a direct effect on intention to use MaaS ($\beta = 0.336$, $p < 0.05$). Thus, H3 is supported. The effect of facilitating conditions on intention to use MaaS is statistically insignificant ($\beta = -0.026$, n.s.). Thus, H4 is not supported. Hedonic motivation has a direct effect on intention to use MaaS ($\beta = 0.267$, $p < 0.05$). Thus, H5 is supported. Finally, price value has a direct effect on intention to use MaaS ($\beta = 0.341$, $p < 0.05$). Thus, H6 is supported.

Subsequently, we conducted a multigroup analysis of the structural model with older age group (N = 323) and the other age group (N = 722) to test H7a to H7f. Prior to hypothesis testing, we compared fit indices of models with equality constraints on path coefficients between independent and dependent variables (constrained model) and different path coefficients between independent and dependent variables (unconstrained model), based on the recommendation of previous research (Ro 2012). In both models, equality constraints were placed on the loadings from the latent variables to the observed variables. In terms of fit indices, we added the Akaike information criterion (AIC) for multiple model comparisons. Comparing fit indices, the results suggest that the unconstrained model fit the data better (see Table 4). The reason is that the unconstrained model has lower CFI, SRMR, and AIC than the constrained model. The results indicates that a moderation effect exists.

Finally, the moderating effect of older age was examined to compare path coefficients between the groups. Table 5 presents the results of multigroup analysis. The effect of performance expectancy on Intention to use MaaS is statistically significant for the Older age group ($\beta = 0.116$, $p < 0.05$), while it is not statistically significant for the other age groups ($\beta = 0.064$, n.s.). Thus, H7a is supported. The effect of social influence on Intention to use MaaS is significantly larger for the older age group than for the other age groups ($z = 2.453$, $p < 0.05$). Thus, H7c is supported. On the contrary, the effect of hedonic motivation on Intention to use MaaS is significantly larger for the other age group than for the older age groups ($z = 2.011$, $p < 0.05$). Thus, H7e is supported. Differences in path coefficients among the other

Table 3. Estimates of standardized path coefficients.

	Path coefficients (β)	p value
Performance Expectancy - > Intention to use MaaS	0.082	0.024
Effort Expectancy - > Intention to use MaaS	0.026	0.308
Social Influence - > Intention to use MaaS	0.336	0.000
Facilitating Conditions - > Intention to use MaaS	−0.026	0.207
Hedoic Motivation - > Intention to use MaaS	0.267	0.000
Price Value - > Intention to use MaaS	0.341	0.000

Table 4. The results of model comparisons.

	χ2	df	CFI	RMSEA	SRMR	AIC
Constrained model	1451.824	485	0.956	0.062	0.050	60,156.461
Unconstrained model	1437.803	479	0.957	0.062	0.049	60,154.404

Table 5. The results of multigroup analysis.

	Older age group		The other age group		z-value of differences
	Path coefficients (β)	p value	Path coefficients (β)	p value	
Performance Expectancy - > Intention to use MaaS	0.116	0.046	0.064	0.166	0.856
Effort Expectancy - > Intention to use MaaS	0.038	0.360	0.040	0.208	0.029
Social Influence - > Intention to use MaaS	0.441	0.000	0.272	0.000	2.453*
Facilitating Conditions - > Intention to use MaaS	−0.024	0.514	−0.029	0.228	0.160
Hedoic Motivation - > Intention to use MaaS	0.154	0.007	0.336	0.000	2.011*
Price Value - > Intention to use MaaS	0.302	0.000	0.349	0.000	0.250

(Note: *p < 0.05).

variables are not statistically significant. Thus, H7b, H7d, and H7f are not supported.

5. Discussion and implications

This study clarifies the determinants of consumers' intention to use MaaS based on UTAUT2. The results show that the research model adequately fit the data and the majority of hypotheses are supported. Specifically, performance expectancy, social influence, hedonic motivation, and price value have significant effects on Intention to use MaaS. However, the effects of effort expectancy and facilitating conditions on intention to use MaaS were not confirmed. It should be noted that there are several studies in which the relationship with intention to use is not statistically significant (Dakduk et al. 2020). Thus, it is possible that in the case of MaaS, the effects of effort expectancy and facilitating conditions were also small and did not result in a statistically significant relationship.

Moreover, the results reveal that performance expectancy and social influence has a greater effect on Intention to use MaaS for the old age group than for the other age groups. In contrast, the older age group is less influenced by hedonic motivation than the other age groups. In terms of the other variables, the age moderating effects of effort expectancy and facilitating conditions on intention to use MaaS were not confirmed. As mentioned earlier, the result may have been caused by the fact that the effects of effort expectancy and facilitating conditions on intention to use MaaS was not statistically significant regardless of the age of the respondents. The age moderating effect of price value on intention to use MaaS was also not confirmed. One possible reason for this result is that price value may have an important influence on the intention to use MaaS, regardless of age.

5.1. Theoretical implications

This study uncovers the structure of MaaS usage intentions in the Asian context based on UTAUT2, through the latest major model for explaining consumer acceptance of new information technologies. While several previous studies utilized UTAUT and TAM to explain the intent to use MaaS (Mola et al. 2020; Ye et al. 2020), the significance of using UTAUT2 is a contribution to the literature. In addition, we examine the moderating effect of age on the intention to use MaaS. To explain MaaS usage intentions, previous studies rarely explored the moderating effect of consumer attributes. In contrast, this study highlights the effect of old age from a practical perspective, thus contributing to the research that examines the structure of MaaS use intention in more detail.

5.2. Practical implications

The results of this study have several practical implications for marketers involved in MaaS development. First, it is important to increase consumers' perceptions of performance expectancy, social influence, hedonic motivation, and price value in order to promote the diffusion of MaaS. In the development of MaaS, it is necessary to develop product specifications that increase efficiency and value for money, and to design an interface that is fun and enjoyable to use. Additionally, spreading the benefits of MaaS through marketing communications and making people aware that the use of MaaS enhances their social status can be effective in increasing social influence. Second, particular focus should be placed on improving performance expectancy, social influence in order to increase the intention of the older age group to use Maas. Conversely, for the older age group, less priority should be given to increasing hedonic motivation.

5.3. Limitations and future research

This study has two limitations. First, it does not measure intent to use a specific MaaS application. Future studies should focus on specific MaaS applications that are being developed in various regions of Asia. In particular, it is important to conduct

verification in Taiwan and Singapore, where the development of MaaS is in progress (Chang, Chen and Chen 2019; Jin and Qiu 2019). Second, it is difficult to discuss the causes of the differences between the results of this study and the study of Lebrument et al. (2021), which uncovered the effect of performance expectancy on intention to use MaaS. For instance, the effects of social influence and hedonic motivation, which are significant in this study, were not significant. It is challenging to specify whether the culture to which the respondents belonged impacted this difference, or whether the prevalence of MaaS in France or other factors did. Future studies should examine this point further.

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Conflicts of interest

The author has no conflicts of interest directly relevant to the content of this article.

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